Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
Inquiry Concerning High-Speed Access to the Internet Over Cable and Other Facilities	)	**GEN Docket No. 00-195**

DECLARATION OF KENNETH J. ARROW, GARY S. BECKER AND DENNIS W. CARLTON

I. QUALIFICATIONS

1. I, Kenneth J. Arrow, am Joan Kenney Professor of Economics Emeritus at Stanford University. I received my B.S. in Social Science at The City College of New York in 1940, my M.A. in Mathematics from Columbia University in 1941 and my Ph.D. in Economics from Columbia in 1951. I have taught economics at The University of Chicago, Harvard University, and Stanford University, and I have written more than 200 books and articles in economics and operations research. I am the recipient of numerous awards and honorary degrees, including the Nobel Memorial Prize in Economic Science (1972). The major part of my writing and research has been in the areas of economic theory, the economics of information and organization, industrial organization, and welfare economics.

2. I, Gary S. Becker, am University Professor of Economics and University Professor of Sociology at The University of Chicago. I also am a Senior Research Associate of the Economics Research Center of the National Opinion Research Center and a Senior Fellow

of the Hoover Institution of Stanford University. I am a member and past president of the American Economic Association. I also am a member of the National Academy of Sciences, the Econometric Society, and the American Statistical Association. I am the recipient of the 1992 Nobel Memorial Prize in Economics which I received for my work in labor economics and other fields. I have written widely on a variety of economic topics, principally in the field of labor economics, and my work has focused on issues such as human capital, the economics of discrimination, the economics of the family and the economics of crime.

3. I, Dennis W. Carlton, am Professor of Economics at the Graduate School of Business of The University of Chicago. I have served on the faculties of the Law School and the Department of Economics at The University of Chicago and the Department of Economics at the Massachusetts Institute of Technology. I specialize in the economics of industrial organization, which is the study of individual markets and includes the study of antitrust and regulatory issues. I am co-author of Modern Industrial Organization, a leading textbook in the field of industrial organization, and I also have published numerous articles in academic journals and books. In addition, I am Co-Editor of the Journal of Law and Economics, a leading journal that publishes research applying economic analysis to industrial organization and legal matters. In addition to my academic experience, I am President of Lexecon Inc., an economics consulting firm that specializes in the application of economic analysis to legal and regulatory issues.

4. Copies of our curriculum vita are attached as Appendix 1 to this affidavit.

II. OVERVIEW AND CONCLUSION

5. We have been asked by Verizon Communications to address whether, given the FCC's stated position that the market for broadband Internet access is competitive, the Commission has an economic justification for regulating local telephone companies offering digital subscriber line (DSL) services while not regulating cable-based Internet services. Verizon has specifically asked us to examine whether, if the Commission's objective is to ensure the competitiveness of markets for broadband access and content while minimizing costs

associated with regulation, the Commission is justified in imposing common carrier regulation on DSL providers and in imposing “line sharing” obligations on local telephone companies offering DSL services, while not imposing such regulations on cable operators. By common carrier regulation we mean the obligation to sell DSL service on a wholesale basis at tariffed rates to unaffiliated ISPs.

6. The FCC has determined that the provision of broadband Internet access is competitive. Under competitive conditions, maintaining such a regulatory disparity would be likely to adversely affect consumers. Imposition of common carrier regulation and line sharing requirements relating to DSL services on local phone companies under competitive conditions could distort prices faced by consumers as well as investment incentives faced by suppliers. Given the FCC’s conclusion that the provision of broadband Internet access is competitive, regulation should not determine which technologies and services succeed in the marketplace.

7. The imposition of common carrier and line sharing rules relating to DSL services on local phone companies when there is competition involving different technologies can penalize otherwise efficient technologies and firms, perhaps resulting in less efficient firms supplanting more efficient ones. The imposition of these regulations under such circumstances can deter investments in broadband Internet access and can discourage future investments in new products and services that make use in part of the local phone system. New products and services are a principal source of the growth of consumer welfare. Regulation that adversely affects incentives to invest in new products and services or that adversely affects the speed with which new products and services are deployed can have very significant adverse effects on consumer welfare.

8. Given the FCC’s assessment of current and future competition in the provision of broadband Internet access to mass market consumers (including residential and small business customers), we conclude that economic efficiency would be promoted if the FCC did not subject local phone companies to common carrier and line sharing requirements relating to DSL services.

9. In the remainder of this affidavit, we first review the FCC's evaluation of the competitive conditions in the provision of broadband Internet access services. We then review the Commission's rationale for requiring local phone companies to share phone lines with other providers of DSL services and to sell DSL services at a tariffed price to Internet Service Providers for resale to consumers, while not imposing such requirements on providers of broadband Internet services over cable facilities (hereafter, cable modem services).

III. SIMILAR BROADBAND INTERNET SERVICES FACE SIGNIFICANT DIFFERENCES IN REGULATORY REQUIREMENTS

A. BACKGROUND ON VARIOUS BROADBAND INTERNET TECHNOLOGIES

1. Description of technologies

10. This section briefly summarizes our understanding of the various broadband Internet technologies that are commercially available or in the process of being deployed. In general, broadband Internet access includes two basic components: (i) transport between the end user and the ISP; and (ii) a connection to the Internet provided by the ISP. The ISP provides the service of contracting for the transport of an end user's traffic over the Internet backbone and may also provide a variety of value-added services such as proprietary content.

11. **Cable**: Cable companies provide broadband Internet access using much the same facilities used to provide cable television services. The services are asymmetric, meaning that more bandwidth is provided from the Internet to end users than from end users to the Internet. Bandwidth available to individual end users is many times faster than that available through dial-up connections, but the actual bandwidth delivered can vary based on a variety of factors including network congestion.[1] We understand that substantial investment is required to upgrade cable facilities to provide broadband Internet access.

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1. FCC, Deployment of Advanced Telecommunications Capability: Second Report, August 2000, ¶¶29-45. (Hereafter, FCC Second Report)

12. **DSL**: DSL services are provided by transmitting digital information using the copper wire lines (or loops) used in the local telephone network. There are a variety of types of DSL services including asymmetric DSL (or ADSL) and symmetric DSL (or SDSL). ADSL services provide greater bandwidth from the Internet to the end user than from the end user to the Internet; SDSL provides equal bandwidth in both directions. The provision of service requires equipment to be attached at the subscriber's location and the phone company's central office. These services can be provided by the local phone company or by an independent firm that leases "unbundled loops" from the phone company or that shares the telephone company's copper wire line. As with cable modem services, DSL services enable consumers to access the Internet at speeds many times greater than dial up connections, depending on congestion and other factors. In practice, local phone companies have been among the principal providers of ADSL services. These services are sold primarily to residential subscribers. SDSL services are sold by independent firms such as Covad, Rhythms, and NorthPoint and are sold primarily to small and medium-sized business customers. We understand that substantial investments are required to provide DSL services and to upgrade copper loops to provide such services.

13. **Other technologies**: Broadband Internet access also can be provided through several other new technologies. As the FCC has noted, Internet access via satellite is now available throughout the United States, although for most satellite customers today, only the downstream path is provided by satellite with the upstream path provided by standard dial-up connection. However, a variety of satellite providers have announced plans to offer service in which both upstream and downstream paths are served by satellite.[2] The FCC has also noted that fixed wireless technology "holds promise for the future,"[3] and that "analysts remain optimistic regarding wireless technology as a competitive broadband provider."[4]

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2. FCC Second Report, ¶56.
3. FCC, Memorandum Opinion and Order in the Matter of Application for Consent to the Transfer of Control of Licensees and Section 214 Authorization from MediaOne Group, Inc., Transferor, to AT&T Corp., Transferee, CC Docket No. 00-251, June 6, 2000, ¶118. (Hereafter, FCC AT&T/MediaOne Opinion).
4. FCC AT&T/MediaOne Opinion, ¶118.

2. Current Scope of Deployment

14. Today, a large majority of broadband Internet subscribers obtain access over cable systems. In June 2000, for example, there were 3.1 million residential and small business high-speed lines. Of these, 70 percent obtained service through cable systems; 25 percent obtained ADSL service, with the remainder accounted for by satellite, SDSL and other services.[5] Between December 1999 and June 2000, there were roughly 480,000 new ADSL subscribers and roughly 775,000 new cable modem subscribers.[6] The FCC projects that while the rate of growth in DSL subscribers will exceed that for cable modem service in the next few years, the number of cable access customers will exceed that for DSL through at least 2004.[7]

15. Broadband Internet access through cable systems also is available to more households than ADSL services. Today, roughly 94 percent of households are passed by cable, and 52 percent of homes are capable of obtaining cable modem service.[8] There are two leading ISPs for cable modem customers. Roughly 2 million customers are served by Excite@Home, which is the exclusive ISP on cable systems operated by AT&T, Comcast, Cox and others; roughly one million cable modem customers are served by Road Runner, which is the exclusive provider of ISP services on cable systems owned by Time Warner and formerly MediaOne.

16. DSL services are not capable of reaching as many customers as cable services due to limitations on the distances at which DSL services can now be provided. Today, ADSL services can be provided up to 18,000 feet from a central office.[9] In total, it is estimated that DSL service can potentially reach about 80 percent of homes,[10] and 27 percent of telephone

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5. FCC, High-Speed Services for Internet Access: Subscribership as of June 30,2000, Table 3. (October 31, 2000).
6. Ibid.
7. FCC Second Report, ¶189, ¶191.
8. FCC Second Report, ¶187.
9. FCC, Broadband Today, A Staff Report to William Kennard, October 1999, Table 2, p. 21.
10. FCC Second Report, ¶38.

company central offices have DSL equipment installed.[11] The leading ADSL providers include SBC (516,000 subscribers),[12] Verizon (350,000),[13] Qwest (213,000),[14] and BellSouth (134,000).[15]

B. CURRENT STATUS OF REGULATION

17. Providers of cable modem services and ILECs that provide DSL services face very different types of regulation. Specifically, the FCC has consistently affirmed its decision not to subject cable modem services to regulations such as those faced by incumbent local phone companies that provide DSL services. As a result, cable modem service providers are now under no obligation to provide Internet transport (between the end user and the ISP) on a wholesale basis to competing ISPs and are under no obligation to share their cable lines with rival providers of Internet access services. In contrast, local exchange providers are subject to both common carrier regulation and line sharing obligations. As mentioned above, by common carrier regulation, we mean the obligation to sell DSL service on a wholesale basis at tariffed rates to unaffiliated ISPs.

18. We understand that there is no technological impediment to providing interconnection to multiple ISPs over cable systems and that cable companies are free to provide transport service on a wholesale basis for resale by rival ISPs, if they choose to market in this way. To date, cable modem services providers have chosen to provide transport and ISP elements of broadband Internet access services on a bundled basis. As noted above, Excite@Home now has an exclusive contract to provide ISP service on cable systems operated by AT&T, Comcast, Cox and others while Road Runner is the exclusive ISP on cable systems operated by Time Warner as well as the former MediaOne systems. We understand, however,

11. FCC Second Report, ¶¶195-6.
12. SBC Press Release, October 23, 2000.
13. Verizon Press Release, October 30, 2000.
14. Qwest Press Release, October 24, 2000.
15. BellSouth Press Release, October 19, 2000

that both AT&T and Time Warner have recently committed to negotiating commercial relationships with rival ISP services to take effect following expiration of the current exclusive ISP contracts.[16]

19. In contrast, incumbent local exchange carriers face a variety of regulatory requirements related to their provision of DSL services. Specifically, local exchange carriers are required to sell DSL transport services on a wholesale basis to rival ISPs, which then bundle these services with ISP services for sale to end users. Local phone companies are required to provide wholesale DSL services on a non-discriminatory basis at a tariffed rate. Accounting regulations are intended to ensure that the tariffed rate approximates the transfer price the local exchange carrier charges to its ISP subsidiary for DSL transport.

20. ILECs are also required to lease a portion of the capacity of phone lines to firms that wish to provide DSL services using a portion of the spectrum available on these lines. This requirement is known as "line sharing." Rival firms that lease this capacity can then attach their own equipment to these lines to provide DSL transport for Internet access. We understand that lease rates for a portion of the loop capacity are below the level that would prevail in the absence of regulation. In establishing guidelines for setting the prices to be charged for line sharing, the FCC concluded that "states may require that the ILECs charge no more to competitive LECs for access to shared local loops than the amount of loop costs the incumbent allocated to ADSL services when it established its interstate retail rates for those services."[17]

IV. THE FCC HAS STATED NO EFFICIENCY RATIONALE FOR REGULATING DSL SERVICES OFFERED BY ILECS

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16. According to an AT&T Press Release dated November 1, 2000, AT&T launched its "AT&T Broadband Choice" trial in Boulder with the following ISPs: Excite@Home, Earthlink, Juno, WorldNet, FriendlyWorks, RMI.net, Winfire, Flashcom. A second multiple ISP trial is being planned for Massachusetts in 2001. Similarly, Time Warner recently committed to allow Earthlink to offer high-speed access over Time Warner cable systems. (Time Warner Cable press release, November 20, 2000.)
17. FCC 99-355, Third Report and Order in CC Docket No. 98-147, Fourth Report and Order In CC Docket No. 96-98, ¶139. (Hereafter, FCC Line Sharing Report.)

A. THE FCC RECOGNIZES THE PRESENCE OF SIGNIFICANT COMPETITION IN THE PROVISION OF BROADBAND INTERNET SERVICES

21. The FCC recognizes the presence of significant competition in the provision of broadband Internet access services. While the FCC has accepted this as a rationale for not regulating broadband Internet services provided by cable, the same reasoning applies to the FCC's decision regarding whether or not to regulate DSL.

22. In a variety of proceedings, the FCC has recognized that competitive conditions provide a basis for not requiring cable modem providers to provide service on a wholesale basis or on a "line sharing" basis. In 1999, the FCC has summarized the state of competition as follows:

> The preconditions for monopoly appear absent. Today, no competitor has a large embedded base of paying residential consumers. The record does not indicate that the consumer market is inherently a natural monopoly. Although the consumer market is in the early stages of development, we see the potential for this market to accommodate different technologies such as DSL, cable modems, utility fiber to the home, satellite and terrestrial radio. The facts that different companies are using different technologies to bring broadband to residential consumers and that each existing broadband technology has advantages and disadvantages as a means of delivery to millions of customers opens the possibility of intermodal competition, like that between trucks, trains and planes in transportation. By the standards of traditional residential telecommunications, there are, or likely will soon be, a large number of actual participants and potential entrants in this market. Anticompetitive coordination among competitors is difficult in such markets.[18]

23. This evaluation of competitive conditions was reiterated in the FCC's June 2000 decision not to impose "open access" requirements in approving the AT&T/MediaOne transaction (subject to requiring AT&T to divest MediaOne's interest in Road Runner). The FCC's reasoning recognized the importance of competition from DSL as well as potential competition from other technologies and cited the requirement contained in the Consent Decree with the Department of Justice that AT&T divest MediaOne's interest in Road Runner.

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18. FCC, Report in the Matter of Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, CC Docket No. 98-146, February 2, 1999, ¶48.

> We find insufficient evidence to support the imposition of an 'open/forced access' requirement on the merged entity at this time, given the potential for competition from alternative broadband providers and the potential for unaffiliated ISPs to gain direct access to provide broadband services over the cable infrastructure.[19]

24. Despite the FCC's recognition of the importance of competition between different broadband Internet access technologies in its decision not to regulate cable modem services, the FCC's decisions subjecting incumbent local exchange carriers offering DSL service to common carrier regulation and line sharing obligations either fail to consider the state of competition or ignore the FCCs' conclusions in other proceedings. For example, the FCC's order subjecting DSL services to common carrier regulation does not address competitive conditions in the provision of broadband Internet access services.[20] Likewise, the FCC's November 1999 line sharing decision concludes that such "sharing is vital to the development of competition in the advanced services market, especially for residential and small business consumers."[21]

B. THE FCC'S REGULATION OF ILECS OFFERING DSL IS INCONSISTENT WITH ITS EVALUATION OF COMPETITIVE CONDITIONS

25. Potential concerns about creating a dominant technology do not provide a rationale for regulating DSL services. As noted above, cable modem service providers now account for a far larger number of broadband Internet customers than DSL and, as discussed above, projections show that cable modem services will have more customers for at least the next several years. As discussed above, a number of firms are in the process of deploying broadband Internet access services using rival technologies. Given the type of "intermodal" competition envisioned by the FCC and projections that DSL will maintain a relatively modest share of broadband Internet subscribers, there can be little concern that local phone companies

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19. FCC, ATT/MediaOne decision, ¶127.
20. FCC Second Report and Order, CC Docket 98-147.
21. FCC Line Sharing Order, ¶5.

be required to provide DSL service on a tariffed basis or be required to share lines in order to prevent local exchange companies from becoming dominant providers of broadband Internet access services.

26. In light of the FCC's evaluation of competition in the provision of broadband services, there is no apparent justification for subjecting DSL services to common carrier regulation or requiring ILECs to share lines with other providers. In the presence of competition from other broadband access technologies, firms that engage in inefficient vertical integration will lose customers to rivals. If broadband transport providers can most effectively market their services by permitting ISPs to resell them, then firms that adopt this strategy will be successful. Similarly, if local loops are most effectively utilized through line sharing, local exchange carriers will enter into such agreements voluntarily in the absence of regulation. If there are efficiencies from bundling transport and ISP functions, then firms would be expected to pursue this strategy. There is no apparent basis for the FCC to conclude that this logic would apply to cable modem service but not DSL service given the FCC's view that both face the same competitive environment.

27. It is also important to note that even in the absence of the common carrier and line sharing regulations faced by local phone companies with respect to DSL services, there would be nothing to prevent independent firms from providing DSL services by leasing loops from local phone companies.[22]

C. CONCERNS ABOUT CREATING MARKET POWER IN INTERNET CONTENT DO NOT PROVIDE A RATIONALE FOR REGULATING DSL SERVICES OFFERED BY ILECS

28. Common carrier and line sharing requirements of the type now faced by ILECs might also be justified as preventing market power in the provision of broadband Internet transport (from the end user to the ISP) from adversely affecting competition in the provision of

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22. FCC Line Sharing Order, ¶34.

"upstream" ISP and broadband content services. This concern had been expressed by GTE in its opposition to the AT&T/MediaOne merger, which would have created a single dominant cable ISP.[23] (As mentioned above, the FCC required the divestiture of MediaOne's investment in Road Runner as a condition of its approval of that transaction.)

29. More specifically, it has been argued that a dominant provider of broadband Internet transport may have an incentive to bundle transport and ISP services in order to achieve market power in the provision of broadband Internet content.[24] In this way, the bundled provider of transport and ISP services might be able to exclude or to penalize providers of broadband Internet content that are unaffiliated with the ISP. If there are scale economies in the provision of broadband content services, exclusion by a dominant provider of broadband access services may be able to adversely affect competition in the provision of content services by forcing unaffiliated content suppliers to operate at an inefficient scale or to be driven from the market.[25] For example, a monopolist of broadband Internet access may choose to establish a preferential relationship with a provider of streaming video content (such as personalized sports highlights). The preferential relationship can ensure that services of the affiliated providers have fewer transmission delays than that of providers of rival services. Under these circumstances, such a vertical relationship could result in a reduction in competition in the provision of personalized sports highlights.

30. This concern, however, provides no rationale for imposing common carrier or line sharing requirements on local exchange providers. As mentioned above, DSL accounts for only

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23. See GTE Comments to the FCC regarding the MediaOne/AT&T transaction (CS Docket 99-251) including the supporting affidavit by Robert Gertner. Carlton (2000) outlines general conditions under which vertical integration by a monopolist may be used to create market power in adjacent markets. (D. Carlton, "A General Analysis of Exclusionary Conduct and Refusal to Deal – Why Aspen and Kodak are Misguided," Antitrust Law Journal, forthcoming).
24. In contrast to this concern, there is typically little cause for concern that an unregulated monopolist will inefficiently vertically integrate into adjacent markets. In a fixed proportion production process, a monopolist in one segment of the industry can extract the full value of its market power without vertical integration.
25. Harm to competition in this scenario also presumes that unaffiliated content services would have been preferred by some consumers relative to the affiliated services.

about 25 percent of Internet broadband subscribers, with the largest provider accounting for less than 10 percent of this total. A content provider that fails to establish a preferential relationship with a single DSL provider has a wide variety of other opportunities to distribute its content.

31. Given the much larger share of broadband Internet subscribers accounted for by cable modem providers, potential concerns relating to preferential vertical relationships could lead to a desire for the imposition of common carrier regulation on cable modem service providers, not DSL providers. The FCC, however, has rejected this alternative based on its conclusions, discussed above, that (i) there is sufficient competition between broadband access technologies; (ii) the fact that cable modem providers appear to have committed to resell transport to at least some ISPs; and (iii) the fact that AT&T was required to divest MediaOne's interest in Road Runner as a condition of approval of its merger by the Department of Justice, thus preventing the creation of a single provider of ISP services for all cable modem subscribers.

D. REGULATION OF DSL SERVICES OFFERED BY ILECS MAY HARM ECONOMIC EFFICIENCY

32. New products and services are a major source of increases in the economic welfare of consumers over time.[26] The rapid growth of Internet services has no doubt resulted in significant increases in consumer welfare. Given the Commission's conclusions that the provision of broadband Internet access is competitive, the imposition of common carrier and line sharing rules relating to DSL services on phone companies can distort prices faced by consumers as well as suppliers' incentives to invest in deploying new technologies and

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26. The importance of new products to consumer welfare and their impact for measuring changes in the cost of living are discussed in The Boskin Commission Report: Toward A More Accurate Measure of the Cost of Living, Final Report to the Senate Finance Committee from the Advisory Commission to Study the Consumer Price Index, December 4, 1996. Also see J. Hausman, "Cellular Telephone, New Products and the CPI," 17 Journal of Business and Economic Statistics 188 (1999) and J. Hausman, "Telecommunications: Building the Infrastructure for Value Creation," in Sense and Respond, S. Bradley and R. Nolan, eds., Harvard Business School Press, pp. 63-81 for analysis of the effect of the Internet on consumer welfare.

services. When competition prevails, it, not regulation, should determine which technologies and services succeed in the marketplace. While this general view has been recognized by the FCC in its reluctance to impose “open access” conditions on providers of cable modem services,[27] the same logic has not been followed with respect to DSL services provided by local telephone companies.

33. The imposition of common carrier and line sharing rules relating to DSL services on phone companies can have significant adverse consequences on competition and consumers. For example, regulators may enable DSL entrants to share the incumbent local carriers’ loop at a price that is below the level that would prevail in an unregulated market. This may discourage incumbent LECs from deploying their own DSL facilities even if they are more efficient providers of DSL services than entrants and may encourage investment by inefficient DSL providers. Similarly, the incumbent carriers’ obligation to provide DSL on a wholesale basis or to share lines with rivals at a tariffed price may adversely affect the speed at which local phone companies choose to deploy existing or new services. Imposition of these regulations on phone companies under competitive circumstances also could adversely affect their incentives to invest in research and development that may extend the range at which DSL services can be effectively provided.

34. More generally, in the presence of competition between technologies, the application of common carrier and line sharing rules relating to DSL services on phone companies can penalize otherwise efficient technologies and firms and can result in less efficient firms supplanting more efficient ones. Such regulatory treatment can discourage future investments in new products and services that make use in part of the local phone system. The application of these regulations on phone companies under competitive conditions can result in a reduction in competition and can contribute to the creation of inefficient dominant

27. See, for example, Address of William E. Kennard, Chairman, Federal Communications Commission before the California Cable Television Association, Los Angeles December 16, 1999, and J. Oxman, “The FCC and the Unregulation of the Internet,” Office of Plans and Policy, Federal Communications Commission, OPP Working Paper No. 31 (July 1999).

technologies. Such concerns are magnified in an industry characterized by rapid technological change since there is less experience for regulators to rely on in designing the appropriate regulatory rules. Moreover, the potential costs to consumers are magnified in such industries due to the importance of new products and services in improving consumer welfare.

35. We understand that a principal goal of the Telecommunications Act is to generate competition in the provision of local telephone services and to stimulate development of new services. If so, then the FCC's conclusion that broadband Internet access is competitive implies that economic efficiency is promoted by enabling local phone companies to realize the benefits of new applications of the local networks.[28]

CONCLUSION

36. The FCC has determined that broadband Internet access is competitive. Under competitive conditions, the imposition of common carrier and line sharing rules relating to DSL service on phone companies would be likely to distort prices faced by consumers as well as investment incentives faced by suppliers, and can result in less efficient technologies supplanting more efficient ones.[29]

37. The potential harm from application of these rules in the presence of competition between technologies is heightened due to rapid innovation in the provision of broadband

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28. While some parties might argue that common carrier regulations and line sharing rules should be imposed to prevent shareholders of incumbent carriers from benefiting from new applications of the telephone network such as DSL, there is no competition-related basis for this argument, given the FCC's evaluation. Moreover, the FCC does not appear to assert that this is a rationale for its DSL resale and line sharing rules.

29. As mentioned earlier, by common carrier rules we mean the obligation to sell DSL service on a wholesale basis at tariffed rates to unaffiliated ISPs.

Internet access. These circumstances complicate the design of efficient regulation and risk delay in the development and deployment of new services, which are important contributors to improvements in consumer welfare. Under these circumstances, competition, not regulation, should determine which technologies and services succeed in the marketplace.

BIOGRAPHICAL SKETCH

KENNETH J. ARROW

Personal

Born: 23 August, 1921
Wife's name: Selma
Children: David Michael and Andrew Seth

Education

B.S. in Social Science, City College, New York, 1940. Major: Mathematics.
M.A., Columbia University, 1941. Field: Mathematics.
Ph.D., Columbia University, 1951. Field: Economics.

Positions

Captain, U. S. Army Air Corps, 1942-46 (Weather Officer).
Research Associate, Cowles Commission for Research in Economics, 1947-49.
Assistant Professor of Economics, University of Chicago, 1948-49.
Consultant, the RAND Corporation, 1948-date.
Acting Assistant Professor of Economics and Statistics, Stanford University, 1949-50.
Associate Professor of Economics and Statistics, Stanford University, 1950-53.
Professor of Economics, Statistics and Operations Research, Stanford University,1953-68.
Economist, Council of Economic Advisers, U. S. Government, 1962.
Visiting Professor of Economics, Massachusetts Institute of Technology, Fall, 1966.
Fellow, Churchill College (Cambridge, England), 1963-64, 1970, 1973, 1986.
Guest Professor, Institute for Advanced Studies, Vienna, June 1964, June 1970.
Professor of Economics, Harvard University, 1968-74.
James Bryant Conant University Professor, Harvard University, 1974-79.
Joan Kenney Professor of Economics and Professor of Operations Research, Stanford University, 1979 to 1991.
Senior Fellow by Courtesy, Hoover Institution on War, Revolution and Peace, 1981-94.
Part-time Professor, European University Institute, 1986.
External Professor, Santa Fe Institute, 1988 to date.
Joan Kenney Professor of Economics Emeritus and Professor of Operations Research Emeritus, 1991 to date.
Fulbright Professor, University of Siena, Spring 1995.

University and Faculty Administration at Stanford University

Executive Head, Department of Economics, 1953-6
Member and Chair, Executive Committee of the Academic Council
Acting Executive Head, Department of Economics, 1962-3
Member and Chair, Advisory Board
Member and Chair, Senate of the Academic Council
Director, Stanford Institute for Theoretical Economics, 1991-93
Director, Stanford Center on Conflict and Negotiation, 1993-5

Honors and Awards

Gold Pell Medal (highest grades), City College, New York, 1940.
Phi Beta Kappa.
Social Science Research Fellow, 1952.
Fellow, Center for Advanced Study in the Behavioral Sciences, 1956-57.
John Bates Clark Medal, American Economic Association, 1957.
LL.D. (honorary), University of Chicago, 1967.
M.A. (honorary), Harvard University, 1968.
Marshall Lecturer, Cambridge University, Spring 1970.
D.Soc/Eco.Sci. (honorary), University of Vienna, 1971.
LL.D. (honorary), City University of New York, 1972.
Nobel Memorial Prize in Economic Science, 1972.
John R. Commons Lecture Award, Omicron Delta Epsilon, 1973.
D.Sci. (honorary), Columbia University, 1973.
D.Soc.Sci. (honorary), Yale University, 1974.
Dr. (honorary), Universite Rene Descartes, 1974.
LL.D. (honorary), Hebrew University of Jerusalem, 1975.
LL.D. (honorary), University of Pennsylvania, 1976.
D.Pol.Sci. (honorary), University of Helsinki, 1976.
Member, National Academy of Sciences (Chairman, Section 54, 1976-1979, Council member 1990 to date).
Fellow, American Academy of Arts and Sciences (Vice President, 1979-80, 1991-94).
Member, American Philosophical Society.
Member, Institute of Medicine.
Foreign Honorary Member, Finnish Academy of Sciences.
Corresponding Member, British Academy.
Sigma Xi (President, Stanford Chapter, 1981-82).
Tanner Lecturer, Oxford University, Spring 1983.
2nd Class Order of the Rising Sun, Japan, 1984.
Tanner Lecturer, Harvard University, Spring 1985.
Dr. of Letters, University of Cambridge, 1985.
Dr. Honoris Causa, Universite d'Aix-Marseille III, 1985.
von Neumann Prize of The Institute of Management Sciences and the Operations Research Society of America, 1986.

LL.D. (honorary), Washington University in St. Louis, 1989.
Clarendon Lectures, Oxford University, November 1989.
LL.D. (honorary), Ben-Gurion University of the Negev, 1992.
Member, Pontifical Academy of Social Sciences.
Laurea (honoris causa) Universita Cattolica del Sacro Cuore (Milan)
Dr. (hon.) Università del Sacro Cuore, 1994.
Dr. (hon causus) University of Uppsala, 1995.
Publication of Enduring Quality Award 1995, Association of Environmental and Resource Economics (with Anthony C. Fisher)
Kampe de Feriet Award (Information Processing for Management under Uncertainty), 1998
Medal of the University of Paris, 1998

Professional Societies

Econometric Society (Fellow; Vice President, 1955, President, 1956, Member of the Council, 1983).
Institute of Mathematical Statistics (Fellow).
American Statistical Association (Fellow).
American Economic Association (Member, Executive Committee, 1967-1969; President-elect, 1972; President, 1973; Distinguished Fellow).
The Institute of Management Sciences (President, 1963; Chairman of the Council, 1964).
Western Economic Association (President, 1980-1981).
American Association for the Advancement of Science (Fellow; Chair, Section K, 1982).
International Society for Inventory Research (President, 1983-1988).
Honorary President, International Economic Association; President 1983-1986; Member, Executive Committee, 1986-1992.
The Society for Social Choice and Welfare, Caen, France, First President, 1992-93.
Economists Alled for Arms Reduction, Co-Chair, 1990-1995

Business Positions

Member, Board of Directors, Varian Associates, Inc., 1973-1991
Member, Board of Directors, Abt Associates, Inc., 1975-1985
Member, Board of Directors, Fireman’s Fund Insurance Company, 1980-1991

PUBLICATIONS OF KENNETH J. ARROW

BOOKS

1. [1951] *Social Choice and Individual Values.* New York: Wiley.

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Academic Degrees

A.B.,	Princeton University, 1951 (Summa Cum Laude)
A.M.,	University of Chicago, 1953
Ph.D.,	University of Chicago, 1955

Honorary Degrees

Doctor Philosophae Honoris Causa, Hebrew University, Jerusalem, Israel,1985
Doctor of Laws, Knox College, Galesburg, Illinois, 1985
Doctor of Arts, University of Illinois at Chicago, Chicago, Illinois, 1988
Doctor of Science, State University of New York at Stony Brook, Stony Brook, New York,1990
Doctor of Humane Letters, Princeton University, Princeton, New Jersey,1991
Doctor Philosophae Honoris Causa, University of Palermo, Buenos Aires, Argentina, 1993
Doctor of Humane Letters, Columbia University in the City of New York, 1993.
Doctoris Honoris Causa Scientiarum Oeconomicarum, Warsaw School of Economics, 1995.
Doctoris Honoris Causa, University of Economics, Prague , 1995.
Doctor of Business Administration, University of Miami, 1995.
Doctor of Science, University of Rochester, 1995
Doctor of Humane Letters, Hofstra University, 1997
Doctor of Humane Letters, University d'Aix-Marselles, 1999

Academic Appointments

Board of Directors, UVext.Com.LLC, 1998-
University Professor, University of Chicago, Departments of Economics and Sociology, 1983 - present;
Department of Economics, 1970 - 1983; Chairman, Department of Economics, 1984-1985
Senior Fellow, Hoover Institution, 1990-present

Ford Foundation Visiting Professor of Economics, University of Chicago, 1969-70
Arthur Lehman Professor of Economics, Columbia University, 1968-69
Professor of Economics, Columbia University, 1960-19680
Assistant and Associate Professor of Economics, Columbia University, 1957-60
Assistant Professor, University of Chicago, 1954-57

Other Appointments

Columnist, *Business Week,* 1985- present
Research Associate, Economics Research Center, N.O.R.C., 1980-present
Affiliated with Lexecon Corp., 1990-1998
Member, Domestic Advisory Board, Hoover Institution, 1973-1991
Member, Academic Advisory Board, American Enterprise Institute for Public Policy Research, 1987-1991.
Associate Member, Institute of Fiscal and Monetary Policy, Ministry of Finance, Japan, 1988-present.
Member, Senior Research Associate and research policy advisor to the Center for Economic Analysis of Human Behavior and Social Institutions, National Bureau of Economic Research, 1957-79
Board of Publications, University of Chicago Press, 1971-75
Professional Societies
American Economic Association (Distinguished Fellow, 1988; President, 1987 Vice President, 1974; Editorial Board, *American Economic Review*, 1968-71)
American Statistical Association
Econometric Society
Economic History Association
Western Economic Association (Vice President, 1995-96; President, 1996-97)
American Sociological Society

Elected Societies

Phi Beta Kappa, Princeton University, 1950,
Member, National Academy of Sciences, 1975-
Corresponding Member, National Academy of Sciences of Buenos Aires, 2000
Member, American Philosophical Society, 1986-
Pontifical Academy of Sciences, 1997-
Fellow, American Statistical Association, 1965
Fellow, Econometric Society, 1967
Founding Member, National Academy of Education, 1965 (Vice-President, 1965-67)
Mont Pelerin Society, 197l; Executive Board, 1985-1996, Vice-President, 1989, President, 1990-92
Fellow, American Academy of Arts and Sciences, 1972-
Member, International Union for the Scientific Study of Population, 1982
Fellow, National Association of Business Economists, 1993-

Awards

Nobel Prize for Economic Sciences, 1992
National Medal of Science Award, 2000
50 Great Americans, Marquis *Who's Who*, 1995
John Bates Clark Medal, American Economic Association, 1967
Phoenix Prize, University of Chicago, 2000
W.S. Woytinsky Award, for Human Capital, University of Michigan,1964
Professional Achievement Award, University of Chicago Alumni Association, 1968

Frank E. Seidman Distinguished Award in Political Economy, 1985
MERIT Award, National Institutes of Health, U.S. Department of Health and Human Services, 1986
John R. Commons Award, Omicron Delta Epsilon,1987
Lord Foundation Award, 1995
Harold Lasswell Award, Policy Studies Organization, 1996
Honorary Member, Gente Nueva, Mexico City, 1996
Irene B. Taeuber Award for Excellence in Demographic Research, Population Association of America, 1997

PUBLICATIONS

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The Economics of Life, (with Guity Nashat-Becker) McGraw-Hill, Inc., 1996; Chinese translation, 1997; German and Japanese translations, 1998;

Accounting for Tastes, Harvard University Press, 1996; Czech translation, 1998; Italian translation, 1999; Chinese translation, 1999

A Treatise on the Family, Harvard University Press, 1981; expanded edition, 1991; Spanish translation, 1987; Chinese translation, 1988

The Economic Approach to Human Behavior, University of Chicago Press, 1976; German translation, 1982; Polish translation, 1990; Chinese translation, 1993; Romanian translation, 1994; Italian translation 1998

Essays in Labor Economics in Honor of H. Gregg Lewis, edited, Special Supplement to the *Journal of Political Economy* 84, no. 2, part 2, August, 1976

The Allocation of Time and Goods Over the Life Cycle, with Gilbert Ghez, Columbia University Press for the National Bureau of Economic Research, 1975

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Economic Theory, A. Knopf, 1971; Japanese translation, 1976

Human Capital and the Personal Distribution of Income: An Analytical Approach, University of Michigan, 1967

Human Capital, Columbia University Press, 1964; second edition, 1975; third editon, 1993, University of Chicago Press; Japanese translation, 1975; Spanish translation, 1984; Chinese translation 1987; Romanian translation, 1997

The Economics of Discrimination, University of Chicago Press, 1957; second edition, 1971

Selected Articles

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"A Simple Theory of Advertising as a Good or Bad," with Kevin M. Murphy, *Quarterly Journal of Economics* CVIII (no. 4): 941-964, November 1993.

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"Government, Human Capital, and Economic Growth," Presidential Address to the Mont Pelerin Society, Vancouver General Meeting, September, 1992, *Industry of Free China* 79 (no. 6): 47-56, June, 1993.

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"Family Economics and Macro Behavior," Presidential Address to the American Economic Association, December 29, 1988, *American Economic Review* 86 (no. 1): March, 1989.

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"An Economic Analysis of Fertility," in *Demographic and Economic Change in Developed Countries, Conference of the Universities-National Bureau Committee for Economic Research*, *a Report of the National Bureau of Economic Research* (Princeton, N.J.: Princeton University Press, 1960), pp. 209-40)

"Union Restrictions on Entry," in *The Public Stake in Union Power*, Philip D. Bradley, ed., Charlottesville, VA: University of Virginia Press, 1959.

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"The Classical Monetary Theory: The Outcome of the Discussion," with W. J. Baumol, *Economica* XIX (76): 355-76, November, 1952

"A Note on Multi-Country Trade," *American Economic Review*, XLII (no. 4): 558-68, September, 1952

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EDUCATION

Ph.D., MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, Massachusetts: Economics, 1975.

M.S., MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, Massachusetts: Operations Research, 1974.

A.B., HARVARD UNIVERSITY (Summa cum laude): Applied Math and Economics, 1972.

ACADEMIC EMPLOYMENT

UNIVERSITY OF CHICAGO, Graduate School of Business (1984 - present): Professor of Economics.

UNIVERSITY OF CHICAGO, Law School (1980 - 1984): Professor of Economics.

UNIVERSITY OF CHICAGO, Department of Economics: Assistant Professor (1976 - 1979); Associate Professor (1979 - 1980).

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, Massachusetts, Department of Economics (1975 - 1976): Instructor in Economics.

OTHER ACADEMIC EXPERIENCE

HARVARD UNIVERSITY, Public Policy Summer Course in Economics (1977): Professor.

BELL TELEPHONE LABORATORIES (Summers 1976, 1977).

JOINT CENTER FOR URBAN STUDIES OF M.I.T. AND HARVARD UNIVERSITY, Cambridge, Massachusetts (1974 - 1975).

FIELDS OF SPECIALIZATION

Theoretical and Applied Microeconomics
Industrial Organization

ACADEMIC HONORS AND FELLOWSHIPS

M.I.T., National Scholar Award, 1968
Edwards Whitacker Award, 1969
Detur Book Prize, 1969
John Harvard Award, 1970
Phi Beta Kappa, 1971
National Science Foundation Fellowship, 1972 - 1975
Recipient of Post-doctoral Grant from the Lincoln Foundation, 1975
National Science Foundation Grant, 1977 - 1985
Recipient of the 1977 P.W.S. Andrews Memorial Prize Essay, best essay in the field of Industrial Organization by a scholar under the age of thirty
Ph.D. Thesis chosen to appear in the Garland Series of Outstanding Dissertations in Economics
Alexander Brody Distinguished Lecture, Yeshiva University, 2000

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

Co-editor, Journal of Law and Economics, 1980 - present
Associate Editor, Regional Science and Urban Economics, 1987 - 1997
Associate Editor, The International Journal of Industrial Organization, 1991 - 1995
Member, American Economics Association, Econometrics Society
National Bureau of Economic Research, Research Associate
Member, Advisory Committee to the Bureau of the Census, 1987 - 1990
Editorial Board, Intellectual Property Fraud Reporter, 1990 - 1995
Consultant on Merger Guidelines to the U.S. Department of Justice, 1991 - 1992
Accreditation Committee, Graduate School of Business, Stanford University, 1995
Visiting Committee, Massachusetts Institute of Technology, Department of Economics, 1995 - present
Resident Scholar, Board of Governors of the Federal Reserve System, Summer, 1995
Member, Advisory Board, Economics Research Network, 1996 - present
Member, Steering Committee, Social Science Research Council, Program in Applied Economics, 1997 - 1999
Participant in meetings with Committee of the Federal Reserve on Payment Systems, June 5, 1997
Participant in round table discussions on "The Role of Classical Market Power in Joint Venture Analysis," before the Federal Trade Commission, November 19, 1997 and March 17, 1998.
Member, Advisory Board of Antitrust and Regulation Abstracts, Social Science Research Network, 1998 - present
Lexecon Inc., 1977 - present; President, 1997 - present.

BOOKS

Market Behavior Under Uncertainty, Ph.D. Thesis. Massachusetts Institute of Technology (September 1975); Garland Publishing (1984).

Modern Industrial Organization, Scott, Foresman & Co., co-authored with Jeffrey Perloff, first edition (1990), second edition (1994); Addison Wesley Longman, third edition (1999).

RESEARCH PAPERS

"The Equilibrium Analysis of Alternative Housing Allowance Payments," (with Joseph Ferreira) Chapter 6 of Analysis of a Direct Housing Allowance Program, The Joint Center for Urban Studies of M.I.T. and Harvard University (July 1975).

"Theories of Vertical Integration," presented at Fourth Annual Telecommunications Conference. Appears in a volume of Proceedings of the Fourth Annual Telecommunications Conference, Office of Telecommunications Policy (April 1976).

"Uncertainty, Production Lags, and Pricing," American Economic Review (February 1977).

"Selecting Subsidy Strategies for Housing Allowance Programs," (with Joseph Ferreira) Journal of Urban Economics (July 1977).

"Peak Load Pricing With Stochastic Demand," American Economic Review, (December 1977). (Reprinted in Economic Regulation edited by P.L. Joskow, Edward Elgar Publishing Limited, 1998.)

"The Distribution of Permanent Income," (with Robert Hall) presented at the Symposium on Income Distribution and Economic Inequality (May 1976). Published in Income Distribution and Economic Inequality, edited by Zvi Griliches, et al. (Halsted Press, 1978).

"Market Behavior with Demand Uncertainty and Price Inflexibility," American Economic Review (September 1978).

"Why New Firms Locate Where They Do: An Econometric Model," in Studies in Regional Economics, edited by W. Wheaton (Urban Institute, 1980). Presented at the Conference on Regional Economics, sponsored by the Committee on Urban and Public Affairs, Baltimore, Maryland (May 1978).

"Vertical Integration--An Overview," in Congressional Record Hearings on the Communications Act of 1978. Bill H.R. 13105 (August 3, 1978).

"Vertical Integration in Competitive Markets Under Uncertainty," Journal of Industrial Economics (March 1979). Awarded the P.W.S. Memorial Prize for the best essay in the field of Industrial Organization by a scholar under the age of thirty.

"Valuing Benefits and Costs in Related Output and Input Markets," American Economic Review (September 1979).

"Contracts, Price Rigidity and Market Equilibrium," Journal of Political Economy (October 1979).

"Benefits and Costs of Airline Mergers: A Case Study," (with W. Landes and R. Posner) Bell Journal of Economics (Spring 1980).

"The Limitations of Pigouvian Taxes as a Long Run Remedy for Externalities," (with G. Loury) Quarterly Journal of Economics (November 1980).

"The Law and Economics of Rights in Valuable Information: A Comment," Journal of Legal Studies (December 1980).

"Price Discrimination: Vertical Integration and Divestiture in Natural Resources Markets," (with J. Perloff) Resources and Energy (March 1981).

"The Spatial Effects of a Tax on Housing and Land," Regional Science and Urban Economics (November 1981).

"Comments on Weicher," Journal of Law and Economics (December 1981).

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"Planning and Market Structure," in The Economics of Information and Uncertainty, edited by J.J. McCall, University of Chicago Press (1982).

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"Futures Trading, Market Interrelationships, and Industry Structure," American Journal of Agricultural Economics (May 1983).

"The Location and Employment Choices of New Firms: An Econometric Model with Discrete and Continuous Endogenous Variables," The Review of Economics and Statistics (August 1983).

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"The Regulation of Insider Trading" (with D. Fischel), Stanford Law Review, (May 1983).

"Economic Goals and Remedies of the AT&T Modified Final Judgement" (with W. Lavey), Georgetown Law Review (August 1983).

"Equilibrium Fluctuations When Price and Delivery Lags Clear the Market," Bell Journal of Economics (Autumn 1983).

"Futures Markets: Their Purpose, Their History, Their Growth, Their Successes and Failures," paper presented at the Columbia University Conference on Futures Markets, February 1984, Journal of Futures Markets, (September 1984). (Reprinted in Futures Markets edited by A.G. Malliaris and W.F. Mullady, Edward Elgar Publishing Limited, 1995.) (Forthcoming in Classic Futures: Lessons from the Past for the Electronics Age, edited by Lester Telser, Risk Books, 2000.)

"Energy and Location," presented at the Brookings Conference on Housing and Energy, Washington, D.C., (November 1981), Energy Costs, Urban Development, and Housing, Brookings Institution (1984).

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Book Review of Tirole's The Theory of Industrial Organization, Journal of Political Economy, (June 1990).

"The Genesis of Inflation and the Costs of Disinflation: Comment," Journal of Money, Credit & Banking, (August 1991, Part 2).

"The Theory of Allocation and its Implications for Marketing and Industrial Structure: Why Rationing is Efficient," Journal of Law and Economics, (October 1991).

"The Economics of Cooperation and Competition in Electronic Services Network Industries," in Economics of Electronic Service Networks, Wildman Steven ed., Praeger Press, (1992).

"Merger Policy and Market Definition Under the EC Merger Regulation," Conference on Antitrust in a Global Economy, Fordham Corporate Law Institute, (1994).

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"Economic Organization and Conflict", Journal of Institutional and Theoretical Economics, (March 1995).

"Antitrust and Higher Education: Was There a Conspiracy to Restrict Financial Aid?" (with G. Bamberger and R. Epstein) The Rand Journal of Economics, (Vol. 26, No. 1, Spring 1995, pp. 131-147).

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"Antitrust and Payment Technologies," (with A. Frankel), Review, Federal Reserve Bank of St. Louis (November/December 1995).

"Antitrust Policy Toward Mergers When Firms Innovate: Should Antitrust Recognize the Doctrine of Innovation Markets?" Testimony before the Federal Trade Commission Hearings on Global and Innovation-based Competition (October, 1995).

"You Keep on Knocking But You Can't Come In: Evaluating Restrictions on Access to Input Joint Ventures," (with S. Salop), Harvard Journal of Law & Technology, (Volume 9, Summer, 1996).

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“Lessons from Halacha about Competition and Teaching,” (with A. Weiss), Clear Profit, 2000 Winter edition (January, 2000).

“Inferring Values from Jewish Attitudes Toward Competition,” (with A. Weiss), Journal of Legal Studies (forthcoming).

“A General Analysis of Refusal to Deal -- Why Aspen and Kodak are Misguided,” Antitrust Law Journal (2000 forthcoming).

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UNPUBLISHED PAPERS

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"The Cost of Eliminating a Futures Market and The Effect of Inflation on Market Interrelationships," (1984).

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"The Choice of Organizational Form in Gasoline Retailing and The Costs of Laws Limiting that Choice," (with A. Blass), (revised September 1999); Working Paper No. 7435, National Bureau of Economic Research, revised December, 1999.
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“The Strategic Use of Tying to Preserve and Create Market Power in Evolving Industries,” (with M. Waldman), Working Paper No. 145, George J. Stigler Center for the Study of the Economy and the State, University of Chicago (1998), revised 1999.

“An Empirical Assessment of Predation in the Airline Industry,” (with G. Bamberger), November, 1999.

WORK IN PROGRESS

Theoretical analysis of firm size, information, price rigidity, and product variety.

Empirical analysis of business cycle effects on firm size distributions.

Analysis of growth of futures markets and the effect of this growth on the industrial organization of related industries.